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REPORT OF THE
BUREAU OF MEDICINE AND SURGERY
ON
BATTLE CASUALTY MEETING



THE SURGEON GENERAL OF THE NAVY
WASHINGTON

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HISTORICALLY, MILITARY MEDICINE HAS GAINED VALUABLE CLINICAL KNOWLEDGE ON THE BATTLE FIELD. AS IN PAST HOSTILITIES, THERE WERE UNPARALLELED SITUATIONS DURING THE VIETNAM CONFLICT FOR STUDYING AND DOCUMENTING PROBLEMS RELATED TO THE CARE AND MANAGEMENT OF THE CRITICALLY WOUNDED IN THE FIELD. THE NAVAL SUPPORT ACTIVITY HOSPITAL, A 700-BED, ACUTE CASUALTY HOSPITAL, LOCATED IN THE NORTHERN-MOST PART OF THE REPUBLIC OF SOUTH VIETNAM NEAR THE CITY OF DANANG, WAS SELECTED AS A SITE FOR SUCH STUDIES.

A SURGICAL RESEARCH TEAM WAS ASSIGNED TO THE HOSPITAL IN 1966. THE PRIMARY EFFORT OF THE TEAM FOCUSED ON PROBLEMS RELATING TO SHOCK AND RESUSCITATION, PULMONARY COMPLICATIONS, AND SYSTEMIC SEPSIS IN COMBAT CASUALTIES.

THE INVESTIGATIONS OF THE COMBAT STUDY WERE CARRIED OUT BY A TEAM OF TWO PHYSICIANS (A GENERAL AND ORTHOPEDIC SURGEON) AND SIX NAVY HOSPITAL CORPSMEN. THE STUDY INCLUDES 1846 CONSECUTIVE AMERICAN MILITARY CASUALTIES. ALL SUBJECTS HAD SUSTAINED OPEN, COMBAT WOUNDS AND WERE SEEN AT THE NSA HOSPITAL FOR THEIR PRIMARY DEFINITIVE CARE.

THE FOLLOWING REPORT DETAILS THE FINDINGS OF THE STUDY. AS THE FINDINGS ARE TRANSFERRED INTO NEW TECHNIQUES AND CONCEPTS FOR DELIVERY OF FIELD MEDICINE, HOPEFULLY, IDEAS CAN BE APPLIED TO SUPPORTING SIMILAR MASS TRAUMA INJURY EPISODES IN THE CIVILIAN SECTOR AS WELL.

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REPORT OF THE
BUREAU OF MEDICINE AND SURGERY
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STUDY PERFORMED AT SURGICAL RESEARCH UNIT
NAVAL SUPPORT ACTIVITY HOSPITAL, DANANG,
REPUBLIC OF SOUTH VIETNAM

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BATTLE CASUALTY STUDY

DR. BERNSTINE

During the period of the study we feel that our guests have assembled some interesting statistics which will provide knowledge that can be used in equipment and hospital design just to mention two areas. Our guests are Dr. James Garrick from the Department of Orthopedics, University of Washington and Dr. Larry Carey from the Department of Surgery, University of Pittsburgh. Dr. Garrick will begin the presentation mentioning the conditions under which the data was collected, and selective aspects of information retrieval. Dr. Carey will review various aspects of the data that he has collected and initiate the discussion.

DR. GARRICK -

Gentlemen, I have some slides which will be of interest. They will detail the method of acquiring the information and the nature of information together with some of its potential uses. As the discussion develops, additional applications for the information will undoubtedly occur to members of the audience. The information was gathered entirely at the NSA Station Hospital, Danang, RVN, from the first of January 1968 to June 1968. The hospital at that time had about 400 to 500 beds and was housed in gounset huts with exception of the newer operating rooms. The helicopter pad, the triage area and the initial casualties staging area were adjacent to each other. The physical appearance of the hospital and areas involved in this study are depicted in the slides.

During the period of the study, there were 2600 casualties treated at the facility but only 2021 of these were allied casualties. The remainder were either Vietnamese, Korean's or POW's and were not included in the study for a variety of reasons. There were 59 deaths in the casualty group for a death rate of 2.92 percent. In the salvageable population we had 42 deaths. Seventeen individuals were declared nonsalvageable at the time of their admission to the hospital.

The patients include all casualties who came to the NSA Station Hospital during this period of time who had received no primary definitive care elsewhere. Some of these people had had resuscitation measures started elsewhere (in the field) but had received no primary definitive care. The majority of the patients came directly from the field, usually by helicopter. There were occasions during the TET offensive when larger numbers of patients had received primary definitive care at other medical facilities and were sent to NSA Danang.

The primary triage area within a quonset hut was capable of handling eight patients simultaneously. The secondary triage area was located between two quonset huts and was capable of handling an additional 20 patients. A resuscitation holding area was later established and was capable of handling 10 patients who were awaiting surgery or who required an unusually long period of resuscitation to prepare them for surgery.

The primary triage area consisted of stretchers placed on standards. Intravenous solutions were suspended from the overhead.

The secondary triage area located between two quonset huts was covered with corrugated metal roof specially fitted with framing for hangers to administer intravenous solutions. Sawhorses were used to support the stretchers. The x-ray facilities consisted of two machines and one automatic film processor. During the middle of the study there was a second automatic film processor installed. It was promptly destroyed by enemy action. So there was actually only one automatic dry film processor throughout the whole study. Only one x-ray unit was used because the processor could only keep up with the one.

Table I details the major facilities at NSA Station Hospital at the time of the study. The differentiation of a major from a minor operating room consists of the number of surgeons who could operate simultaneously.

There were debridement facilities in various clinics in the hospital. They were capable of handling six patients simultaneously. Patients with what were considered as minor wounds were treated in these areas. Minor in the sense that the wounds were superficial and didn't involve major joints or major fractures and did not require anything more than local anesthetics. There was a major post-surgical recovery unit for 12 patients throughout most of the study.

Table II enumerates the staff by specialty. The exact number of general medical officers varied from time to time.

FACILITIES - NSA STATION HOSPITAL

Danang, RVN January - June 1968

X-ray Facilities	
Hospital Unit	1
Dry Film Processor	1
Operating Rooms	
Major (4 surgeon capacity)	2
Minor (1-2 surgeon capacity)	3
(Includes 1 expandable MUST unit)	

TABLE II

SURGICAL PERSONNEL-N.S.A. STATION HOSPITAL

Danang, RVN	January - June 1968
Anesthesiologists	3
Anesthetists (Nurse)	2
General Surgeons	3
Orthopedists	4
Neurosurgeons	2
Urologist	1
Ophthalmologist	1
Otorhinolaryngologist	1
Oral Surgeon	1
Surgical General Medical Officers	3

We used a team of 6 corpsmen, who were assigned to the project, to gather information on which this study is based. This was their only duty. Precoded sheets were used, and as each casualty was brought into the triage area it was determined whether they required primary definitive care and if an interview was possible. At times, information was gathered from the individuals who accompanied the casualties. Each patient in this study was followed on a daily basis by one of these 6 corpsmen. They followed the patient to the operating room, determined the amount of blood and fluids that were used; followed them through their entire hospital course; in some instances, through the evacuation system. The corpsmen abstracted the operative notes. All the information was sent back and key punched onto IBM cards at Bethesda.

We've organized the information in a number of ways to demonstrate how one might use it. Initially, we explored the data for possible correlation between prior wounding and the ability to escape any further wounds. The relationship between prior wounding and the subsequent occurrence of a fatal wound was investigated. The percentage probably reflects the status of all military in RSVN at that time. (Table III)

In the majority of cases we were able to establish wounding agent by the history. (Table IV) If this was not possible the Navy Explosive Ordnance Disposal Team would identify fragments and shrapnel removed from the casualty. The wounding agent accounting for most casualties was artillery including mortars; gunshot wounds were second, some of which were multiple. Wounds due to booby traps were third.

TABLE III

RELATIONSHIP OF PRIOR WOUNDING TO SUBSEQUENT OCCURRENCE OF A FATAL WOUND

PRIOR WOUNDS (Purple Hearts)	LIVING		DEAD		TOTAL	
	No.	Percent	No.	Percent	No.	Percent
0	1612	87.7	11	64.7	1623	87.5
1	187	10.2	4	23.5	191	10.3
2	36	2.0	2	11.8	38	2.0
3	3	1.6	0	0	3	0.2
3	0	0	0	0	0	0
No Data	(124)	-	(42)	-	(166)	-
Total	1962		59		2021	

TABLE IV
WOUNDING AGENTS

2021 Total Casualties
59 Deaths

WOUNDING AGENT	NO. OF LIVING	PERCENTAGE OF LIVING*	NO. OF DEAD	PERCENTAGE OF DEAD*
Gunshot	526	26.0	14	23.7
Artillery	825	40.8	13	22.0
Grenade	171	8.5	1	1.7
Mine/Booby Trap	399	19.7	12	20.3
Burns	34	1.7	2	3.4
Other	24	1.2	0	-
Multiple	62	3.1	2	3.4
Unknown	87	4.3	19	32.2

*Based on total casualties and total dead

Next, correlation between type of wounding agent and duration of duty in RSVN was evaluated.. Certainly we'd all heard that in field medical service school or from the Marines (the majority of these patients; at least over half of the study were Marines) that there was a kind of attrition curve. As one spent more time in the country one learned more about mines and booby traps, so there was a likelihood of receiving wounds from different kinds of agent. You can see that there is generally a decrease in the frequency of wounding as the tour goes on for the individuals and I suspect some of this is not learning curve but some of this is a function of units being moved out of country and prior wounding. The interesting thing is that if you look at the part of the casualty load caused by mines and booby traps that there is a suspicious peak at the first month. The statistician tells me that that peak is significant with the numbers involved here and indeed it does seem to be a learning curve at least insofar as being wounded by mines or booby traps. Most of the mine and booby trap injuries occurred during the non-TET periods and generally prior to the TET offensive (January and February of that particular year)

Figure 1, Wounding Agents vs Combat Experience

Table V presents the data as to the location of individual at the time he was wounded. The number wounded while in an aircraft is expectedly low.

FIGURE 1 - WOUNDING AGENT VS COMBAT EXPERIENCE

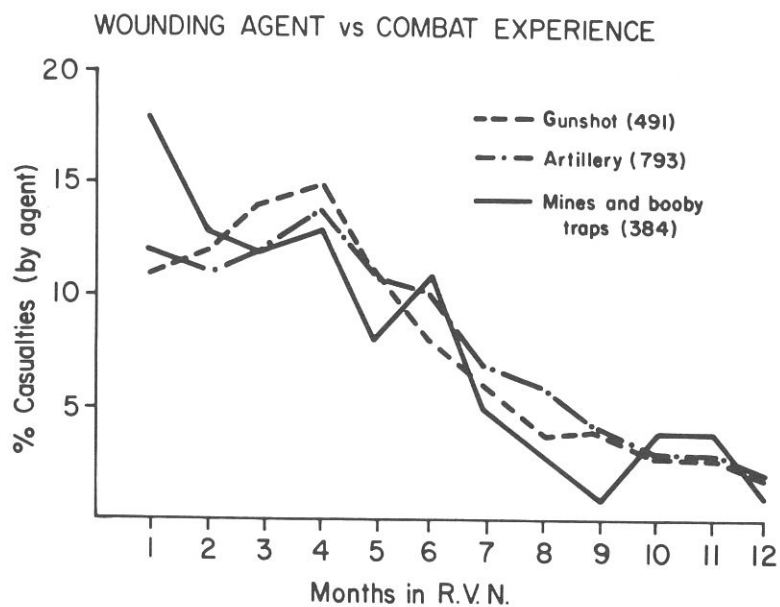


TABLE V

LOCATION OF CASUALTY AT TIME OF INJURY

Location	Number	Percent
Afoot	1677	83.0
Vehicle	114	5.6
Aircraft	52	2.6
Building	63	3.1
Unknown	115	5.7
Total	2021	100.0

Figure 2 relates the evacuation time to the severity of the wound. As I pointed out earlier, major wounds were those requiring one of the operating rooms; in other words, either head, chest or abdominal wounds or extensive extremity wounds that couldn't be handled with local anesthesia, or extremity wounds that involved major fractures, or major joints. The time of injury until they arrived at the hospital is represented in this figure. Thus, we find that there is little difference regarding severity of wounds and evacuation time.¹

Figure 2, Evacuation Time vs Severity of Wounds

Almost 28 percent of the major cases required more than 6 hours of triage time for lack of more efficient air evacuation. Thirty percent of the minor wounds required more than 6 hours to be evacuated. Fifty-nine percent of our entire casualty load came when there were five or fewer people in the triage area. About 11 percent of the casualties were taken care of while there was one person in the triage area. When more than five casualties were in the triage area at one time, it was considered a mass casualty situation. The facts behind this reasoning was that we were capable of operating on five patients simultaneously. (Figure 3)

Figure 3, Triage Load at Time of Admission

¹A later study (Cameron, B. J. and Older, H.J.: Marine Corps Medical Evacuation Procedures in Vietnam, April 1970) reviewed helicopter evacuation and found a mean mission time of 1 hour and 49 minutes from onset of injury to delivery of the casualty at a medvac hospital facility. The mission required 64 minutes for completion. In a practical sense, this indicates that 50 percent of the casualties (4,392) on whom data were gathered reached a medvac hospital facility approximately 1 hour or less from the time they were injured.

If only the time from deployment of the helicopter to arrival of the casualty at a hospital facility is considered, the median mission time is reduced to 31 minutes.

FIGURE 2 - EVACUATION TIME VS SEVERITY OF WOUNDS

EVACUATION TIME vs SEVERITY OF WOUNDS

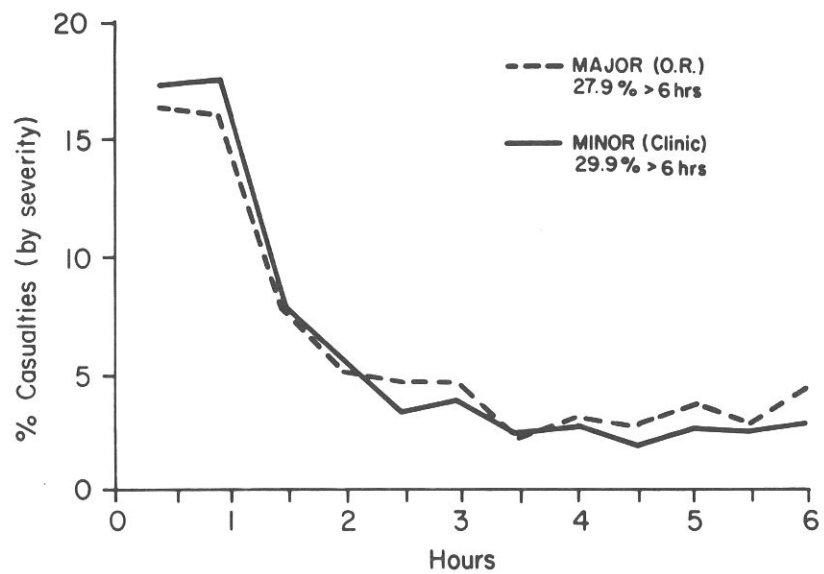


FIGURE 3 - TRIAGE LOAD AT TIME OF ADMISSION

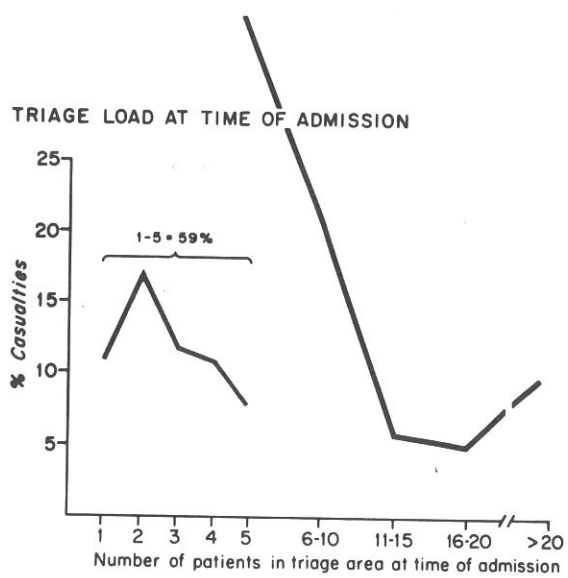


Table VI depicts the type of surgery that was performed. As one would expect there were no deaths in the minor surgery category. Of the entire wounded group, there is a preponderance of casualties requiring major surgical intervention. This situation is due in part to the presence at Danang of a neurosurgeon and an ophthalmologist. They were the only specialists of this sort ashore in the I Corps area. For this reason, certain kinds of casualties would gravitate to our facility. A little later this is shown more graphically when we start looking at head wounds. Thus, the casualty load at Danang is not wholly typical and reflects the availability of certain specialists in the hospital.

The type of anesthesia that was used is represented in Table VII. Patients requiring general, spinal or regional anesthesia generally had their surgery performed in the major operating room. This table compares the survival of the casualty undergoing surgery with respect to the type of anesthesia employed. Majority of cases performed under local anesthesia were done in the clinic area. Those that required no anesthesia either had very minor wounds or did not require debridement.

The time from admission to the triage area until the casualty was released either to active duty or to some other disposition demonstrates a great peak at 2 days. Only about 7% of casualties remained in our facility more than 10 days. (Figure 4)

Figure 4, Time From Admission to Release

FIGURE 4 - TIME FROM ADMISSION TO RELEASE

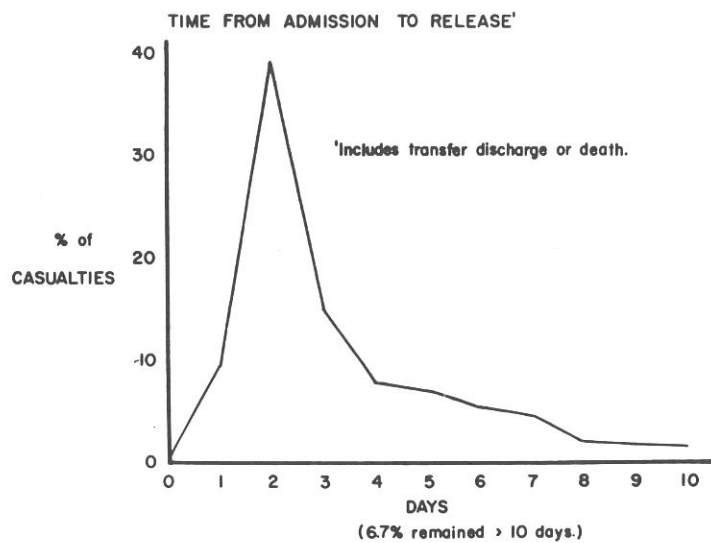


TABLE VI

SURGICAL SURVIVAL ACCORDING TO DEGREE OF SURGERY

TYPE OF SURGERY	LIVING		DEAD		TOTAL
	NO.	PERCENT	NO.	PERCENT	NO.
Major	1172	96.6	42	3.5	1214
Minor	755	100.0	0	0	755
None	35		17		52
Total	1962	97.1	59	2.9	2021

TABLE VII

SURGICAL SURVIVAL ACCORDING TO TYPE OF ANESTHESIA

TYPE OF ANESTHESIA	LIVING		DEAD		TOTAL NO.
	NO.	PERCENT	NO.	PERCENT	
General	675	94.7	38	5.4	713
Spinal	357	99.5	2	0.6	359
Regional	221	99.2	2	0.9	223
Local	841	100.0	0	0	841
None	132		17		149
Total	1962		59		2021

It is interesting to note where the patients went from our facility. Eight percent returned to duty and 15 percent to other facilities in the country. This last group was discharged to one of the medical facilities in Cam Ranh Bay area where the patient could be rehabilitated within the country. The majority of these patients returned to duty. Nine percent were evacuated to hospital ships, 62 percent entered the evacuation chain and 2.4 percent went directly back to the United States. (Table VIII)

The casualty load in the TET and non-TET periods varies in many respects. There is a change in the type of wound. During the TET period there were a few more gunshot wounds, many more artillery type wounds. There were fewer mine and booby trap injuries and grenade wounds (Table IX)

Figure 5 represents the total number of casualties plotted against the evacuation time. This is a cumulative graph so that any point in this line, indicates the percentage of the casualties that have been evacuated to that point. For example at 5 hours, during the total study, over 60 percent had been evacuated and, at the same period during the TET offensive, only 48 percent had been evacuated. If you were to look at the non-TET period by its self, it would lie above the upper line. In the majority of cases this was a result of patients being sent to other medical facilities, sometimes for a long period of time.

Figure 5, Evacuation Time

The time from admission to definitive treatment does not present any major differences.

FIGURE 5 - EVACUATION TIME

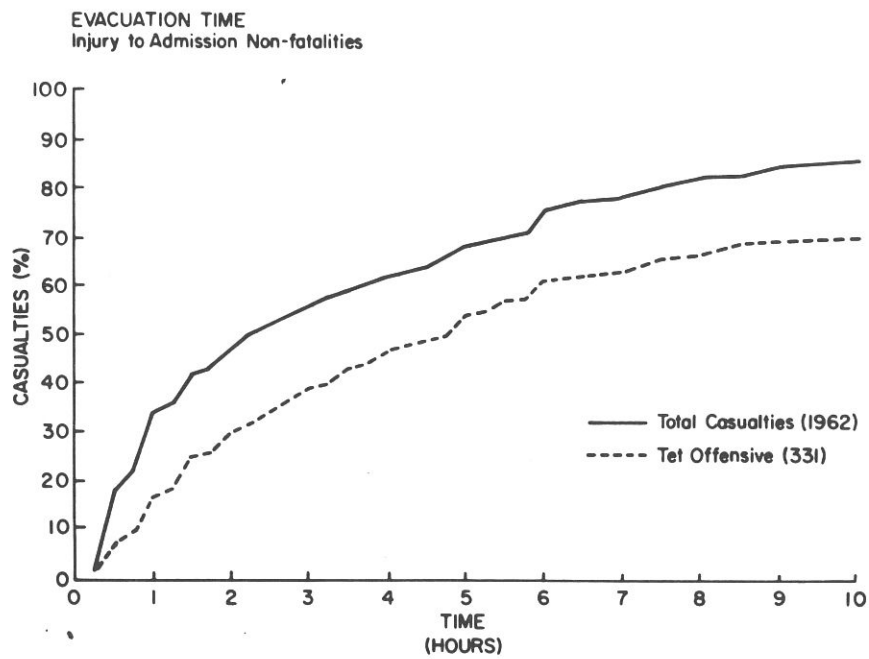


TABLE VIII

DISPOSITION OF CASUALTIES

LOCATION	NUMBER	PERCENT
Released Alive	1962	97.1
To Duty	160	7.9
"In Country"	312	15.4
Hospital Ship	183	9.1
"WEST-PAC"	1247	61.7
CONUS	49	2.4
Unknown	11	0.5
Died	59	2.9
Total	2021	99.9

TABLE IX
WOUNDING AGENTS (TET vs NON-TET)

WOUNDING AGENT	TET (342)		NON-TET (1679)	
	No. of Casualties	% of TET Casualties	No. of Casualties	% of Non-TET Casualties
Gunshot	97	28.4	429	25.5
Artillery	185	54.1	627	37.3
Grenade	25	7.3	146	8.7
Mine/Booby Trap	22	6.43	277	16.5
Multiple	(12)	(3.51)	(50)	(3.0)
Unknown	19	5.6	68	4.1

Figure 6, Elapsed Time From Admission to Definitive Treatment

There were no differences during the first hour, thus regardless of how busy the hospital was, those people who were truly of emergency nature and required life saving procedures were treated as fast if the triage area was crowded or not. During the TET offensive about 65% of the patients were out of the hospital within 48 hours. During the non-TET period only about 30 percent. (Figure 7)

Figure 7, Time in Hospital (admission to Release or Death)

Comparison of wound site and wounding agent is presented in figure 8. Multiple extremity wounds occurred most frequently following mine and booby trap accidents. The proportion of head wounds requiring neurosurgical intervention constitutes a small percent of mine and booby trap injuries. The gunshot wounds rarely involved more than one extremity. The relationship of wounding agent to the type of facility required for care of the resultant injury will indicate in general terms hospital design.

Figure 8, Wound Site vs Wounding Agent

Figure 9 relates the use of surgical facilities to wounding agent. The frequency of the requirement for a major operating room was less with mines and booby traps than gunshot wounds. Again this particular fact is weighted by the presence of a neurosurgeon.

Figure 9, Surgical Facilities vs Wounding Agent

Figure 10 relates the type of anesthetic to the wounding agent. Local and regional anesthesia were utilized for debridement. The use of general anesthesia was greatest in mine and booby trap injuries.

FIGURE 6 - ELAPSED TIME FROM ADMISSION TO DEFINITIVE TREATMENT

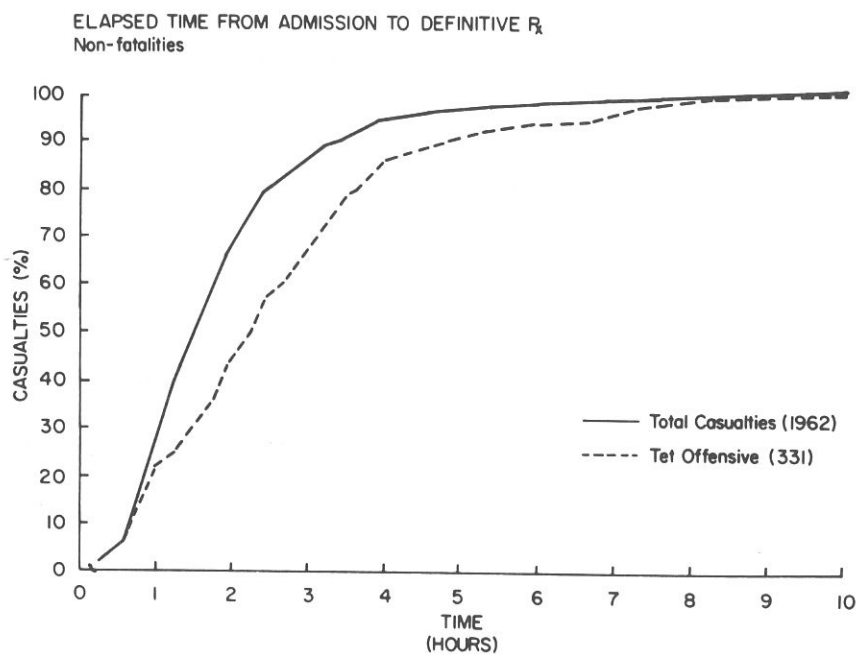


FIGURE 7 - TIME IN HOSPITAL (ADMISSION TO RELEASE OR DEATH)

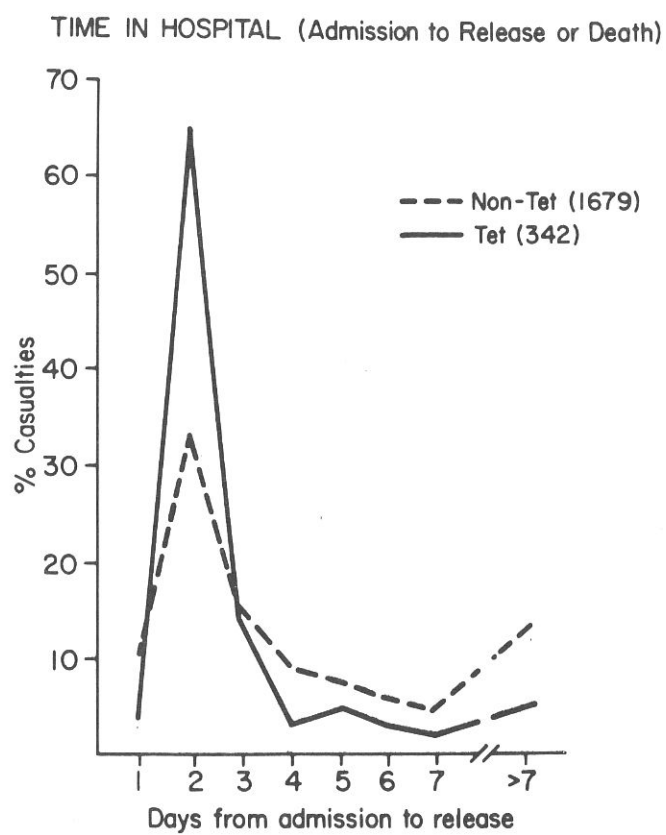


FIGURE 8 - WOUND SITE VS WOUNDING AGENT

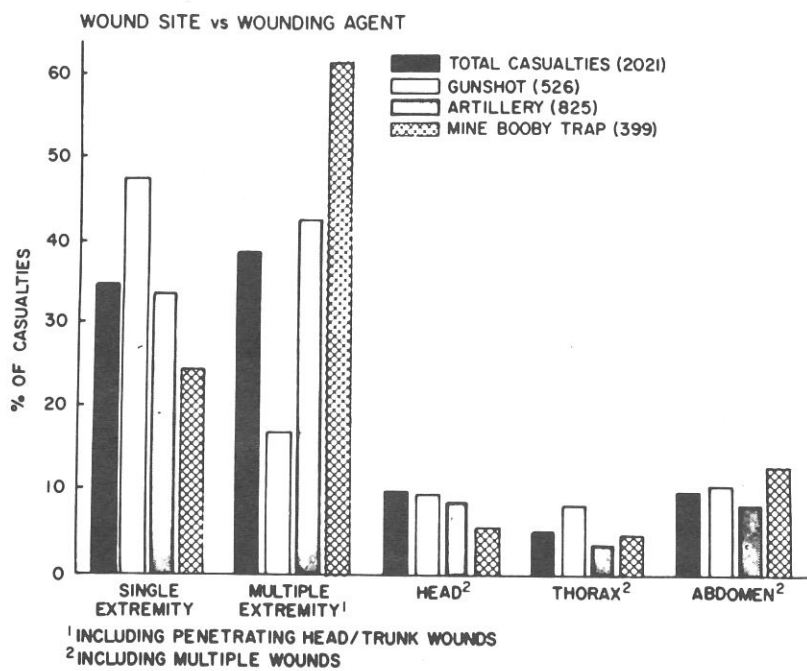


FIGURE 9 - SURGICAL FACILITIES VS WOUNDING AGENT

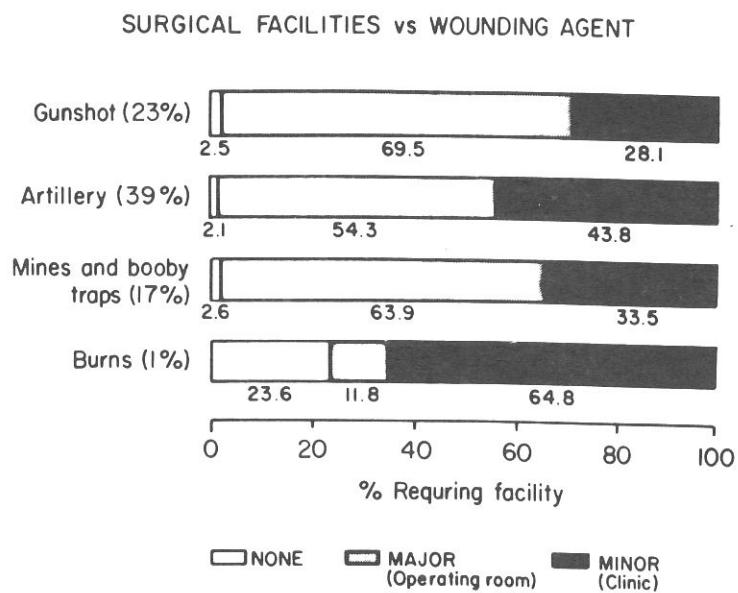


Figure 10, Type of Anesthetic vs Wounding Agent

Mines and booby trap injuries generally required more blood. This is particularly evident when the total blood requirement exceeds seven or eight units. The blood requirements for casualties from artillery or gunshot injuries are relatively unchanged. (Figure 11)

Figure 11, Blood Requirements vs Wounding Agents

Figure 12 demonstrates the relationship of wound site and hospital stay. Aside from extremity wounds which have a peak incidence at two days, the rate of discharge for various types of wounds is not changed during the study interval.

Figure 12, Wound Site vs Time From Admission to Discharge

Consideration of location of the wound and its relationship to mortality is presented in Table X. The type of wound will indicate the specialists required for medical care and suggest manpower needs. Approximately 10 percent of the casualties had head wounds requiring a neurosurgeon; eight percent had eye wounds which required an ophthalmologist.

Table XI presents the mortality statistics for penetrating wounds of the head, thorax and abdomen individually and in various combinations. From this information, we can get an appreciation of the number of surgeons that would be required for various wound sites. Patients generally tolerate the shorter operative time and anesthesia time during a combined surgical approach rather than a series of individual consecutive procedures. This approach allows a greater number of casualties to be treated in the operating rooms.

FIGURE 10 - TYPE OF ANESTHETIC VS WOUNDING AGENT

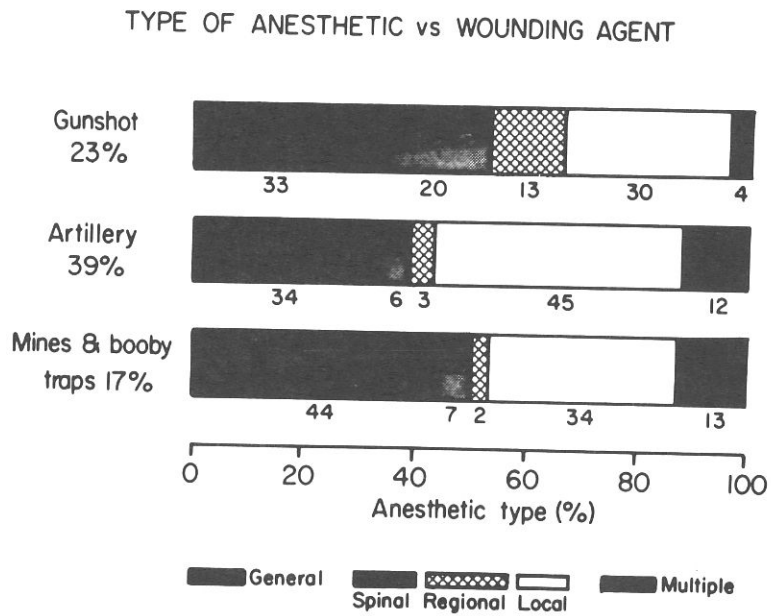


FIGURE 11 - BLOOD REQUIREMENTS VS WOUNDING AGENTS

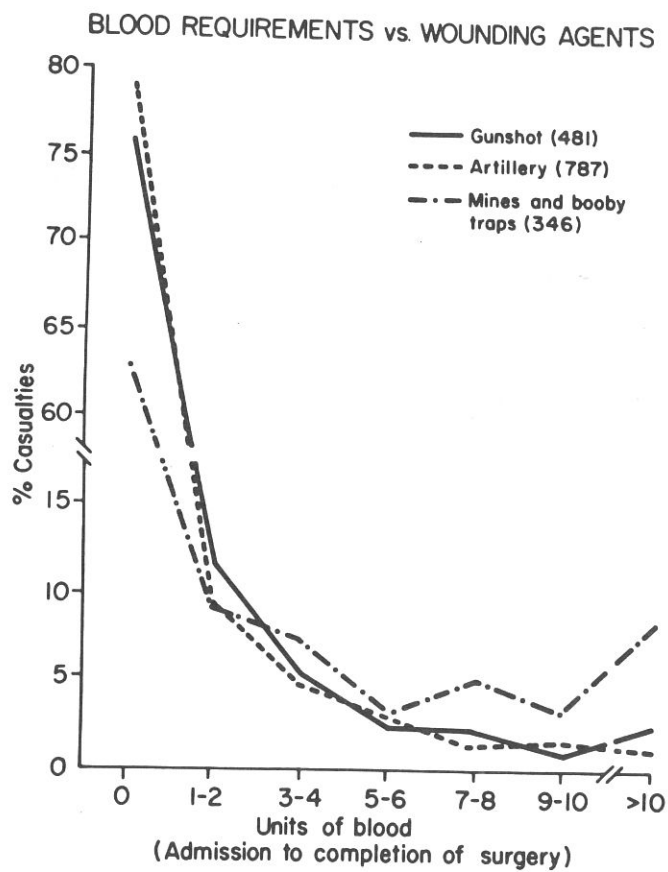


FIGURE 12 - WOUND SITE VS TIME FROM ADMISSION TO DISCHARGE

WOUND SITE vs. TIME FROM ADMISSION TO DISCHARGE

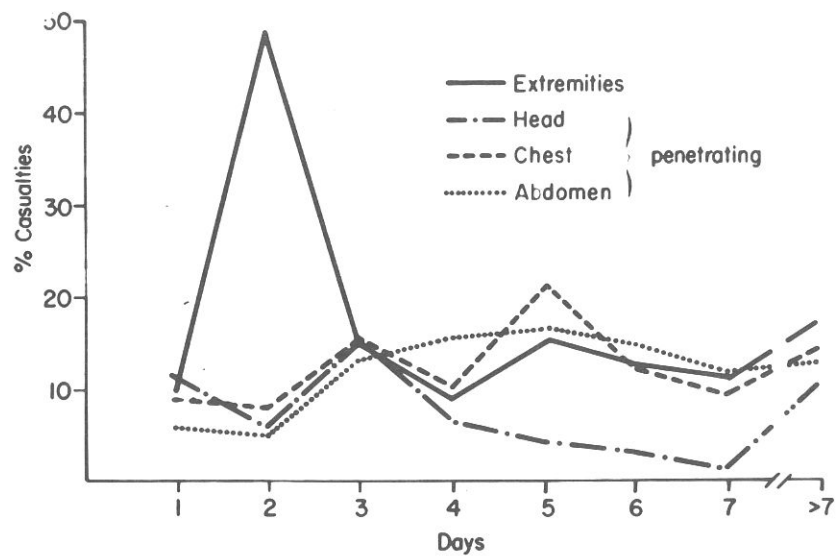


TABLE X

DEATH vs WOUNDS

Penetrating Head, Thorax and Abdomen
458 (22.7%) of 2021 Casualties

Site(s)	No. of Casualties	% of Total Casualties	No. of Dead	% of Category Dead
HEAD (Total)	199	9.8	36	18.1
Alone	178	8.8	27	15.2
THORAX (Total)	117	5.8	12	10.3
Alone	72	3.6	3	4.2
With Head	7	0.3	3	42.9
ABDOMEN (Total)	201	9.9	19	9.5
Alone	150	7.4	7	4.7
With Head	13	0.6	6	46.1
With Thorax	37	1.8	6	16.2
With Head and Thorax	1	0.1	0	-

N.B. Only 7 deaths resulted from wounds not included in above categories.

TABLE XI

WOUND LOCATION - TYPE

(Head and Neck)

LOCATION/TYPE	No. of Casualties	% of total Casualties	No. of Dead	% of Category Dead
HEAD				
Penetrating	199	9.9	36	18.1
Non-penetrating	186	9.2	4	2.2
EYE	157	7.8	6	3.9
ORAL	60	3.0	3	5.0
FACE				
ENT	194	9.6	9	4.7
Non-ENT	315	15.6	13	4.2
NECK	217	10.7	13	6.0
Carotid Artery	14	0.7	2	14.3
Jugular Vein	9	0.5	0	-
Trachea	16	0.8	0	-
Esophagus	4	0.2	0	-
THORAX				
Penetrating	117	5.8	12	10.3
Non-penetrating	228	11.8	5	2.2
Diaphragm	10	0.5	0	-
BACK				
Spine	46	2.3	11	2.2
Non-spine	196	9.7	6	3.1
ABDOMEN				
Penetrating	201	9.9	19	9.5
Non-penetrating	109	5.4	4	3.7

TABLE XII

PENETRATING NECK WOUNDS

122 Explorations
9 Deaths (7.4%)

STRUCTURE	Casualties	% of Neck Expl.	No. of Deaths	% Dead of Struct. Involved
Trachea Larynx	16	13.1	0	-
Esophagus	5	4.1	0	-
Cervical Cord	6	4.9	2	33.3
Carotid Artery	14	11.5	2	14.3
Jugular Vein	9	7.4	0	-

Penetrating neck wounds should be explored. Table XII demonstrates the type of injuries which will be encountered.

The type of organ involvement that was seen in penetrating abdominal wounds (201 patients) is illustrated in Table XIII. There were sixty negative explorations as related to major organ involvement.

Table XIV presents the amputation performed in our hospital or amputations present at time of admission. As one might expect, finger amputations were most frequently encountered. Lower **extremity** amputations were more frequent than upper extremity amputations. The majority of these amputations resulted from mine and booby trap injury.

Review of the number of arterial injuries (Table XV) reflects the need for a sophisticated surgical staff to treat the casualties at Station Hospital, Danang, RSVN.

Units of blood transfused between time of admission and the conclusion of the initial definitive surgery is presented in Figure 13. Approximately 10 percent of the casualties required greater than 15 units of blood during this period of time.

Figure 13, Blood Transfusions

Table XVI compares the blood requirements to the wound site. Wounds involving extremities required less blood transfusions than those involving other anatomic areas. Considering only the patient requiring blood, an extremity wound requires about six units of blood per patient while a penetrating abdominal wound an excess of eight units. The blood requirements for patients with head wounds are lower since the majority of these wounds result from a single missile. This information completes the data base of this study.

FIGURE 13 - BLOOD TRANSFUSIONS

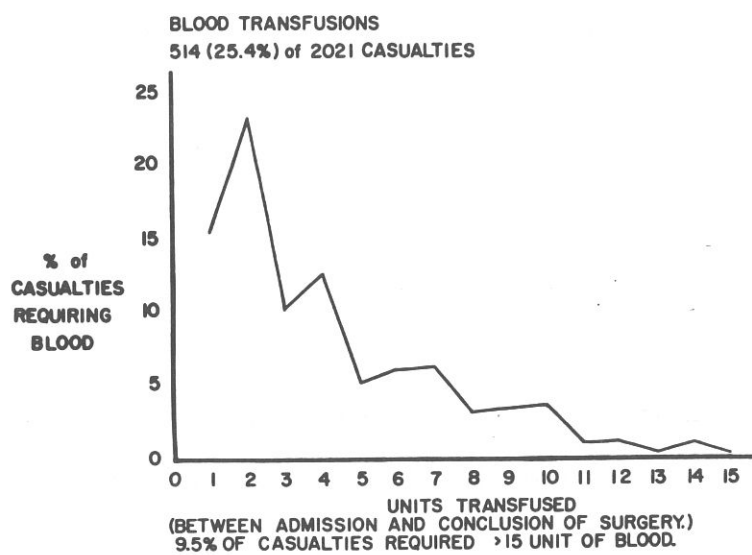


TABLE XIII

SPECIFIC ORGAN INVOLVEMENT - PENETRATING ABDOMINAL WOUNDS

(201 Casualties)

(60 Negative Explorations)

ORGAN	No. of Casualties	% of Abd. Explor.	No. of Deaths	% Dead of Organ Involved
Stomach	19	9.4	1	5.3
Duodenum	5	2.5	2	40.0
Small Bowel*	67	33.3	6	9.0
Colon	57	28.3	9	15.8
Rectum	10	5.0	4	40.0
Liver	39	19.4	6	15.4
Spleen	19	9.5	2	10.6
Pancreas	3	1.5	0	-
Kidney	17	8.5	3	17.7
Bladder/Urethra	13	6.5	3	23.1

*Exclusive of duodenum

TABLE XIV
AMPUTATIONS (ON ADMISSION OR PRIMARY)

Level	Number	Percent
Above elbow	3	1.5
Elbow	3	1.5
Below elbow	4	2.0
Wrist	7	3.5
Hand	4	2.0
Fingers	49	24.6
Above knee	21	10.5
Knee	30	15.1
Below knee (high)	32	16.1
Below knee (low)	25	12.6
Ankle	3	1.5
Foot	7	3.5
Toes	11	5.5
Total	199	99.9

TABLE XV

MAJOR ARTERIAL INJURIES

(3.3% of all casualties)

Artery	Number	Percent
Axillary	2	3.0
Brachial	21	31.3
Femoral	20	29.9
Popliteal	7	10.4
Common carotid	6	8.9
External carotid	4	6.0
Internal carotid	7	10.4
Total	67	99.9

TABLE XVI
BLOOD REQUIREMENTS¹ vs WOUND SITE

	Casualties	Blood/ Patient	Requiring Blood Number	Blood %	Blood/Patient Requiring Blood
EXTREMITIES (No major head or trunk wounds)	1563	0.83	219	14.0	5.90
HEAD ² (Penetrating, all)	196	2.85	122	61.3	4.65
CHEST ² (Penetrating, all)	117	4.72	75	64.1	7.36
ABDOMEN ² (Penetrating all)	201	6.09	151	75.1	8.11

¹ Admission to completion of surgical procedure

² Categories overlap

DR. CAREY - Initially I would like to make a couple of comments of things about which I have strong feelings. One quickly became impressed with the remarkable adequacy of the equipment. There was almost never a time when we felt as if we didn't have the equipment that we needed to get the job done; however, there were other frustrations. It appeared occasionally that there was a lack of communication between the various medical facilities and helicopter pilots who were transporting the patients. Patients arrived with head wounds at hospitals where there were no neurosurgeons. Patients came to our hospital, at times, when we simply could not accommodate any more patients. We would call a nearby Marine Hospital to find that the hospital was not fully occupied. It was quite clear that we needed a substantial improvement in communications, so that the people who were evacuating patients could know, while in the air, what facilities were available, the various kinds of special procedures they performed and the relative range of activity of each medical facility. I understand that many of these deficiencies were corrected after Dr. Garrick and I left Danang.²

²This deficiency was recognized and in early 1969, a medical regulating center was established at Danang to correct it. The center listed on a timely basis all available beds, operating rooms, hospital capabilities, etc. and was in constant radio communication with med-vac helicopters.

The lack of triage in the field was disturbing. It seemed, at times, that patients who had a minor wound were moved to the hospital with about the same frequency or time interval as patients who had major wounds. In a break down of wounds, there are almost identical number of wounds of the abdomen (which is a fairly big anatomical space) and wounds of the head (much smaller anatomical area). The same observation applies to wounds of the chest as compared to wounds of the head. This suggests that body armor was more effective at protecting the individual than were the helmets.³ There appears to be a substantial need for improvement in the mechanics of protecting individuals from head wounds. The importance of this fact is emphasized when one considers that of 59 total deaths in the study, 36 had only head wounds. If you remove the patients with head injuries from the mortality statistics only 22 remain.

Most of the data that has been presented was from the interest stand point of Dr. Garrick and myself. We need to know from the line what their requirements might be from this data. We have a large amount of data from which information can be obtained rather quickly. I know we have information that you could profitably use.

Now with respect to the question that Captain Miller asked about this type of research in future conflicts. There are several things to be considered. One is that there needs to be prior planning, and I think it ought to be organized across service lines. A group of

³ The question arises whether the troops wore their helmets.

consultants should help with the preparation and design of protocols. Two major areas of research would be involved. Clinical research, which the present study reports and secondly research for development of military equipment for medical use. The latter areas was not neglected in the present conflict. A portable suction pump and both respiratory and membrane oxygenators were tested. There is a tremendous cadre of people developing in this country who are interested in trauma. As you know the number of people killed per year in automobile accidents exceeds the total number of people killed in Vietnam. Cooperation between these civilian facilities and the military should be mutually beneficial.

It appears to us that for any military operation where air superiority was assured that battalion aid station ought to be eliminated as a place to care for battle casualties. They do a good job in handling the minor problems but, generally, the **badly** injured patients treated at battalion aid station do not have their condition improved. It is more important to get these casualties to a place where they can be definitively treated initially.

Another area where there could be some substantial improvement is in the development of training for physicians prior to their arrival in the combat zone. Every physician had to have several weeks to months of training to learn to function properly in this medical environment. People who arrived in Danang from residency program where there was an active trauma service with an equally busy emergency rooms were quite efficient and did not require prolonged indoctrination to handle the

problems in RSVN. If they came from less active hospitals they required a much longer period of time to adjust and become a useful member of the team. We can help alleviate this problem in several ways. One way would be to select from career military physicians a group of people to be specially trained in the surgery of trauma. They could receive part of their training in civilian trauma centers where there is a large volume of patients. They should have periodic refresher courses in the management of shock, and severe injury. An alternative (and I think this is a poor secondary alternative) to establishing this kind of continuing training for military physicians is the possibility to develop a cadre of Ready Reserve from the civilian trauma centers. These people would be available to be activated quickly to assist in setting up hospitals and getting personnel trained, in event of a conflict.

The question of transplantation, in the combat area has been raised. I believe that there would be relatively little need for renal transplantation in the kind of facility that was operating in Danang. A patient who requires a kidney transplant may be evacuated to receive this treatment. There are adequate methods for keeping people alive without kidneys. Other organ transplants where there are no alternate support systems may be considered in the future for transplantation in a combat area. This may include the liver and the heart. There were five heart wounds in the six month period that arrived at the hospital alive and of those five, four ultimately survived. Thus, it appears that the need for heart transplantation is not very great.

There were 39 wounds of the liver in the group of 2000 patients. Some of these casualties may have benefited from liver transplantation. The expense and sophisticated technique necessary for accomplishing that kind of surgery probably doesn't justify its development in a military hospital in a battle zone.

The difference in survival between patients with penetrating abdominal wounds in the Korean War (12 %0 and the Vietnam War (10%) is not large. Since Korea, there has not been substantial improvement in survival with penetrating abdominal wounds involving colon, small bowel, stomach, kidney or spleen. Our hospital mortality of three percent is not very much different than the hospital mortality at the busy field hospitals in Korea. This is colored a bit by the fact that we greatly shortened the evacuation time so we saw more casualties with serious wounds. It was difficult in Korea (where the mean evacuation time was 3 hours) to evacuate a casualty with a penetrating wound of the heart to the hospital for surgery. This was true for major liver wounds, as well. Major wounds of the liver are such that they do not tolerate long transportation periods.

The ratio of wounded to killed from World War I, World War II, the Korean War and Vietnam is amazingly constant until the present conflict. The wounded killed ratio for World War I, World War II and Korea (average of all) is about three to one, but in Vietnam it is almost seven to one. I think this change is the result of helicopter evacuation of casualties. The improvement in the method of transportation allows casualties to arrive at the definitive care centers soon after they have been wounded.

A few calculations will emphasize this difference. There had been 200,900 people wounded in the Vietnam War at the time this data was prepared. If you are to achieve a ratio of three which is the mean wounded - killed ratio for the previous wars, how many people would have been killed? The answer is 96,000. Actually 43,800 have been killed so there is a theoretical saving of 53,000 lives.

The accomplishments presented today are significant. Due to improvement in transport, there is a group of casualties who present with wounds incompatible with life. In addition, the results demonstrate an improvement in care, which becomes more difficult to determine as the excellence of care continues at a very high level.

There are areas where additional thought is required to design proper research protocols. For example it was apparent that shock is a major problem but its management has become sophisticated enough so that further improvement will probably occur slowly. The mortality rate for a group of 66 badly wounded patients who were in severe shock (about one-half of them had blood pressure which was unobtainable) on admission was about nine percent. There were only three patients in that 66 who did not respond to treatment. In terms of treating shock, this is a rather good performance. The thing that became quickly apparent to all of us, was that we did not do equally well in treating infection. I am convinced that well over half of the deaths of the patients who survived past four days in this war are related to infection. This is an area where research would be profitable.

It is possible with the tactical employment of Marines being considered, we may have to accept longer helicopter rides for medical evacuation. Is there any advantage of putting Corpsmen in the helicopters? Yes, I think if you cannot shorten the time from injury to admission to the definitive center, then the next best thing is try to improve the treatment in the course of the transportation time.

The reason why we have taken such a strong stand against the battalion aid station is for two reasons; first, there really isn't an awful lot they can do under the circumstances. They do not have the equipment. They do not have help. They do not have space; secondly the treatment of shock is not so urgent in most cases that another few minutes will make a significant difference; and the third thing and I think perhaps the most important is the lack of ability of people in the field to recognize the problems in the patients. Until we can improve that situation I can't really justify using battalion aid stations for patients requiring further surgery.

Some discretion by the corpsmen in the field may be required if the number of casualties temporarily exceed the evacuation capability. The helicopter pilot is primarily interested in getting the casualty to medical care rather than to a particular hospital. Our facility tended to have the more seriously injured casualty and yet almost 40 percent of our load was patients with minor injuries. This indicates that helicopters were called to evacuate casualties that really did not need evacuation. In many instances, their trips were into insecure areas. Clearly, more efficient triage could be practiced.

CAPT ADAMS - Can we go back to the question of corpsmen in the helicopter for a minute? Given mean helicopter rides of an hour and a half should we have corpsmen on these choppers?

DR. CAREY - If you are talking about means of an hour and a half than probably not. The risk of personnel doesn't justify the potential gain. Starting an intravenous and attempting to establish an airway on a helicopter is not an easy undertaking. You just can't do much on that helicopter. To address the question more directly, is there any place for corpsmen on helicopters? I think it depends on the length of ride because there is no question that the longer a human is in shock the less your chances are of getting him to respond when you start to treat him vigorously. I don't think I can pinpoint an exact number of hours for a helicopter ride that would be a key to treatment.

CAPT ADAMS - We have wrestled with this in civilian situation as to whether or not we ought to try and have helicopter evacuation from automobile accidents.

DR. CAREY - Generally in the urban centers the answer is no. Some 60 percent of them died of head wounds and it probably wouldn't have made any difference had they been evacuated an hour earlier or four hours later. The group that remains in the non-head wound deaths is very, very small.

CAPT ADAMS - What would be your recommendation in regards to time in the aid station while being treated?

DR. CAREY - The answer will depend on whether there is control of air evacuation routes. If you don't have control of the air, then you take care of the patients where you can get them cared for most quickly. The name of the game is clearly "early treatment".

CAPT ADAMS - I think you should clarify your remarks that experienced personnel must be present at these facilities. Many times, civilian experiences do not prepare a physician for the realities of war. This subject leads directly into the question of how the military will maintain a group of physicians experienced in combat surgery. As the combat situation winds down, the expertise will tend to diminish.

DR. GARRICK - Capt Adams, may I answer both your questions or try? I think that one of the points that Dr. Carey was trying to make was that what you say is very true, and I think regardless of what type of training program we came through, all of us went through a great sinking spell when we entered the operating room the first time and saw somebody with 400 holes in him. This question leads directly into the means of the military maintaining a group of physicians experienced in combat surgery. As the combat situation winds down, the expertise will tend to diminish with passage of time.

CAPT ADAMS - I think that one of the points that Dr. Carey was trying to make is important, and regardless of what type training program we came through, all of us went through a great sinking spell when we entered the operating room for the first time and saw a patient with many wounds. It is a frightening experience for someone who is used to having contact with men age 26 to 28. There is a learning curve for each new physician.

DR CAREY - I think we should address ourselves to the fact that there is a big difference between civilian type trauma and military type trauma. Nobody told us what to expect.

CAPT ADAMS - Yes, the expertise was gained in the last few years, yet there is little instruction for physicians. The Army does a little. They say you will treat a certain type wound in a specified way. We didn't do it too much in this war, but it has been done in the past.

DR. GARRICK - Wound closure is an area which could profitably be a subject of instruction. We could tell when new physicians reported to the battalion aid stations. We would start seeing a rash of closed wounds - closed infected wounds. They probably seemed minor out in the field and they were resistant to refer them to hospitals. There was pressure from their unit since they didn't want to lose the man. Our plea is directed more towards training which is geared to the type of problem before you take a group of people like Larry and I who were reservists and 21 days following induction were managing casualties.

CAPT ADAMS - I agree. A selective, intensive course to prepare physicians is required. One which is geared to combat medical problems that they will be treating for the first time.

DR. GARRICK - I think that there is a large group of ex-military physicians who are now civilians who have a very vital interest in this matter. There were many people in our hospital who did research projects on their own and who became very, very interested. If there would be some mechanism to keep their interest high, even if they get out of the

service, the Navy would have a base of sound experience to utilize.

You know Navy medicine has a lot of friends.

DR. CAREY - I agree entirely with what Jim has said. If you can show by hard, cold facts how it really is in war situations and develop appropriate instructional material, I believe, we could accomplish the purpose we all believe is necessary. We must prepare the physician for the real work he will be performing in the combat situation.

CAPT ADAMS - May I ask a question about the number of orthopedic surgeons and the evacuation procedure. I notice that you had four orthopedic surgeons aboard. By the time I got out there, one of the medical battalions had eight orthopedists. You were evacuating your extremity wounds within two or three days. At the same time we had eight orthopedists in one of the medical battalions, there was only one orthopedist back at Pendleton for definitive orthopedic care. I would like to hear comments on this arrangement?

DR. CAREY - It depends to some extent on who has the right to do what to which and to whom. The extremity wounds in our hospital were all managed by orthopedists. All of the soft tissue as well as the skeleton injuries were managed by orthopedists. Thus the orthopedic service by large took care of a great number of patients. Probably 70 percent of the population who had extremity wounds had an orthopedic flavor to them. Yet on the other hand, as was done in some other hospitals, general surgeons handled all of the soft tissue wounds and orthopedists confined themselves strictly to those having skeleton involvement. You can see that the number of orthopedists each facility required would

be vastly different. Who should define each specialist responsibility?

CAPT ADAMS - Do you mean that the orthopedists that were brought over had no choice?

DR. CAREY - No, I think it was a local decision.

CAPT ADAMS - I think that the decision also involves our total assets. It seems to me that the place where the orthopedists is most needed is where final definitive surgery and rehabilitation is performed.

DR. CAREY - I think Jim would agree very quickly that the challenge of the orthopedic injury didn't post much of a professional thrill to the orthopedist when he was really just picking out big pieces of bone and putting on casts. There wasn't much in the way of reconstruction or any kind of really interesting orthopedic work. I would tend to agree with what you say, the major need for the orthopedists is back at the state-side hospital when the patient starts the process of rehabilitation and reconstruction and not at the time of debridement.

DR. GARRICK - At Danang, we started out with approximately even numbers of general surgeons and orthopedists. The extremity wounds were really all we could do as orthopedists and so we did the extremity wounds while the general surgeons operated on all other areas of the body. The orthopedic community, with some justification, believe that the extremity wounds might get better care if cared for by an orthopedist. He is familiar with the anatomy. That's the major area he operates on. But if what you say is true, then the shortage is in CONUS where you really need the orthopedist for reconstructive procedures.

CAPT ADAMS - Do you have any comments regarding the adequacy of training for the operating room technicians?

DR. CAREY - I am trying to think what type of data would be applicable. I really don't know how I could express it with these figures. It is my opinion that the operating room technicians were superb, but we did not have shortage of technicians. The biggest problem we had was the anesthetists and anesthesiologists. It was easier to justify a surgeon, a neurosurgeon or an orthopedic surgeon. You say to yourself we have four orthopedists and four general surgeons but we don't have eight anesthesiologists or eight anesthetists. Unfortunately, no matter who else is working, the anesthesiologist or anesthetist is required.

DR. GARRICK - During TET offensive we had to close down our hospital for 12 hours because all of the anesthesiologists had been going for 48 straight hours and could not stay awake at the head of the table. There should be at least a 1:1 ratio. For everyone who operates there should be some one to provide anesthesia.

DR. CAREY - A lot of surgery was done under blocks and spinals. This was done because of the physical layout of the operating room. There was one at either end of the quonset hut with the sink in the center. An anesthesiologists could sit with two patients if they had received blocks. This is the reason we presented the information regarding types of wounds and kind of anesthesia required. If you get situations where there are many head wounds or abdominal or chest wounds, then you need an anesthesiologist for every table.

DR. GARRICK - We had a few dental officers who were willing to do anesthesia and who had enough training to be able to do it with supervision or we would have been in more difficulty.

CAPT ADAMS - We have the possibility that if we get into another conflict we will have better residents, and we will have computer ability to process the information more readily. Would you suggest the types of data we should collect that we didn't collect this time.

DR. GARRICK - Very quickly, I can think of some data that we collected that we shouldn't have collected.

CAPT ADAMS - Of course, you were keeping your own-talley sheets, but suppose you had to deal with our medical records, what sort of numbers would you recover?

DR. GARRICK - We couldn't have done this. I think that the success of this study, if indeed it has been successful, was primarily due to the Commanding Officer of the hospital. He thought it was a good idea that we collect the information. Dr. Carey and I and six corpsmen were essentially the only people involved in this study. The total cost of this study to date has been minimal. I think the important thing to those involved in the study, was a labor of love because we were very interested in it and found it fascinating. The corpsmen provided us with excellent information. I know that any kind of a record system that is going to give information that can be used for future planning requires people who care to keep the records. The computer is only as effective as the information one provides it. These six corpsmen were dedicated and devoted.

They gave up off duty hours. They worked any time they were asked to. They set up their own call system so that if the casualty load exceeded the capacity or more than one man there was always a backup man. They were diligent about going to the wards and getting follow-up information when they hadn't been able to fill out all the blanks on the sheet at the time of admittance.

DR. CAREY - Jim and I would go over the sheets every 24 hours. For each 24 hour period, we would get the duty group together and go through the list and ask why a block was not filled out. It was only through a constant review process that we were able to be confident that we had really obtained all the information that could be obtained and the circumstances of how it happened.

CAPT ADAMS - We should be able to make the information a useful thing. We should be able to compile information on wounds, as to areas, incidence, periods, types of wounds, mortalities, etc., from our routine records, but we can't do it.

DR. CAREY - I think that for this kind of material and this kind of output I would foresee an extended study not dissimilar in approach to our study.

CAPT ADAMS - I'm inclined to agree when you want detailed information there is no resemblance to general information. For any particular hospital you show only the number of days that the individuals were in that hospital. Then you dispose of them in a number of ways. Some die; most are evacuated to other medical activities and some are discharged. The number of hospital days is not going to tell you anything other than

how many patients you are going to have to take care of in a hospital of this type under similar circumstances. It doesn't tell you how many theatre beds you need. How many CONUS beds you need? How many total casualties you should be prepared to care for within the system? Those numbers are more like mortality figures.

DR. CAREY - It is absolutely certain that more of these patients died than we could record because we could only count the ones that we saw die. We have no idea what happened to the others.

CAPT ADAMS - This is also something else the surgeons in the field complain about. They never know what happens to the patient after he left the command. At one time, there was a device for some kind of follow-up system but I don't know how will it worked.

DR. CAREY - We would get information by handling a subsequent patient evacuated with an escort. The escort would go with a list of patients to determine their disposition.

CAPT ADAMS - Could you find most of them?

DR. CAREY - Yes, if we knew accurately where the patient had been evacuated, and this had occurred within a week or 10 days previously, we could get reasonable good figures. I think this information is one of the areas where further research would be of some value. One could make some predictions about facility needs, if you can predict what kind of an ordnance is going to be involved. With this information, I think we can give you good input as far as the kinds of wounds one would encounter and the facilities required to treat the casualties.

CAPT ADAMS - I think the weapons and progress of the war are going to change rather rapidly. Our assumptions during the first few weeks of the war did not hold true for a very long period of time.

DR. CAREY - Just as in this study. If you subdivide the total study period, each part is entirely different from the other.

CAPT ADAMS - Following World War II, several of us tried to find medical contingency plans for possible combat areas. We were not able to find any plans or the information they would contain. How many anticipated casualties, number of hospital beds needed, etc. Does the information you have gathered, help us in this area for future planning? Can we project requirements more accurately utilizing this data?⁴

DR. CAREY - We can probably give you answers to some of these questions. The information presented today does not begin to exhaust the possibilities of this material. If you have specific questions, we will be glad to try to provide the answers. We can talk about ordnance, we can talk about pure medical problems, a little bit about triage, evacuation time; we can talk about hospital facilities. If you would be a little patient with us, we can give it to you in a tabulated form. But I don't know where to go, in fact, neither of us know where to go with all of this information right now.

⁴At the Bureau of Medicine & Surgery, up-to-date medical contingency plans exist which delineate the numbers of patients, medical officers, paramedics, etc. that would be needed depending upon the number of people in the theater of operations, time phased for both nuclear and non-nuclear warfare.

CAPT ADAMS - I think you have used what is important and you have presented it very well, but there is an absolute need for training.

DR. CAREY - The best information I got at LeJeune was from a Marine Sgt. who simply filled us in on the nature of the country, something about the people, some understanding of the kinds of wounds that would be seen.

CAPT WITWER - Do you really think that you can train for this kind of eventuality or new development without some kind of realistic war situation.

DR. CAREY - You clearly can't get people ready to step into the job they are going to do and have them be able to do it efficiently. But that really isn't what training is all about in my opinion. My business, is training surgical residents and I know very well that the day my senior resident leaves me and goes in private practice, he may see a surgical problem he has never seen before. If he had been trained properly he will have some idea about a proper course of action or at least know where to find it. But I think the answer to what you say is No, you can't train a man to be capable of doing a given job which he has never done or never seen before. But there are certain ground rules; there are certain repetitive skills, there are certain value judgements that you can get him ready to make.

The first night I was on duty as triage duty officer, the Air Force Base was rocketed. We had 75 casualties in 45 minutes for my

initial experience, but there were enough knowledgeable people around and it became a learning experience for me.

DR. GARRICK - I did train surgeons before I got my present job and I think that my residents, when they finished their training were well trained residents, but it wasn't until they came under actual battle condition that they knew what to expect in combat injuries. I have mentioned several times about training in the intervallum period. You can't expect to send an individual surgeon to a special training center and then take that surgeon and send him to a war situation and expect him to operate efficiently. He requires anesthesiologists trained under the same conditions. He requires corpsmen and operating room nurses trained under the same conditions. It is almost impossible to choose this in a realistic manner, but it is possible to train them as you indicate. Train them so that when they get into that combat situation they will quickly and efficiently adapt to the problems.

DR. CAREY - I don't agree with you entirely. I think that there is an entirely different mental outlook, and nervous system preparedness for dealing with the severely injured as opposed to dealing with the elective surgical problem. A man who has had experience dealing with the severely injured in any numbers is a hell of a lot better military surgeon the day he arrives in country, than a physician who came from a hospital where that kind of patient population doesn't exist.

DR. GARRICK - Agree with you, but how do you provide this kind of background.

DR. CAREY - Well, I don't know. A possible mechanism is to put these guys some place where they will be exposed to that type of experience even for a short time, or bring people into the military who are from that environment until you get the machinery working. This group of people can then train others at the scene of action. We have put together some relevant training material which I can show you later if you wish. It is a superficial attack on the subject but at least it shows the kind of casualty one will see. Another subject covered is basic debridement. How do you debride a wound? Management of the surgical casualty is presented in another sound-slide group. The last one details the problems that you encounter with wounds from specific ordnance. Mine and booby trap injuries have different problems.

(Speaker unidentified) - Some of data was included in NATO handbook which I'm sure a lot of surgeons neglected to read. I'm sure we can spend a lot of time making sound slides and they would be well received, but the problem again is how do you develop the surgeon's interest in this field.

CAPT ADAMS - I would like to develop a community team. Now this was done in World War I and World War II, I don't think it was done in the Korean War, and I know it wasn't done in this current war. It is more difficult to stimulate the interest of more than one individual at a hospital if only the director ever served; however, the community is made aware of this greater responsibility, by forming a disaster team or a war team which could be deployed as a unit. (This is West Cantankerous Hospital Unit that goes to the combat zone and sets up this

this hospital) I think this might very well go over.

DR. CAREY - I think there are enough people scattered around where you could pick single individuals at individual hospitals and just say organize a team. If they are excited enough about it, they will get other people excited and interested and it won't be a problem.

CAPT ADAMS - Yes, but I think if you can get a whole group of people pulled into it, you will have a much easier time then if you try to rely on one here and one there.

DR. CAREY - No, but if you have an individual there he can find others to fill out his team.

(Speaker unidentified) - I would envision that we could train our own Navy surgical team in the same manner but our problem is find the institution where he could place this surgical team as a unit. Would there be institutions willing to accept a whole surgical team, say in a trauma center?

DR. CAREY - I don't know. They may rather accept individuals.

CAPT RUPNIK - Yes, but would they accept a team? A group that could come into the emergency room and operate as a surgical team. This really would tie a group together.

DR. CAREY - The peculiar thing is that there are very few military hospitals who deal with trauma. The military needs some basic training. Trauma training is different than general surgery. It is different than general orthopedics. That is the first thing one should realize. There is a difference in the way a physician responds if he has been trained in the management of severely injured as opposed to a well trained

general surgeon who has never seen a gunshot wound.

CAPT ADAMS - Ed, I think we would have trouble making teams. I think any Chief of Service could not allow several of his people to leave for a month or two.

CAPT BERNSTINE - Ed, if Dr. Eiseman is anxious to see this concept go, perhaps he'll get behind it.

DR. CAREY - There are a host of excellent institutions, Parklawn, Cook County, Cherry Hospital, New Orleans, Bellvue, Milwaukee County Hospital and Cincinnati General, that would have no problem at all absorbing an individual and giving him substantial experience in this kind of problem.

CAPT ADAMS - If practical, you could include the anesthesiologists.

DR. CAREY - You might do this on individual basis to start with. A surgeon, an anesthetist, an orthopedist and then all of them could work together to form a team. By the same token, at the height of the war in Vietnam, what percentage of all specialties in RSVN were reservists.

CAPT. ADAMS - About 95% I would guess.

DR. CAREY - I think that the teams have got to be split, you've got to have some civilians.

(Speaker unidentified) - Have you had any occasion to compare the data that you gathered with any Marine hospital.

DR. GARRICK - Yes, informally. In fact, it was kind of the grand plan when we started all of this that the same kind of program might be instituted in the 3rd Medical Battalion.

DR. CAREY - I think their comparable figures would show some

differences. They wouldn't see as many head wounds. They would have a higher percentage of wounds of a minor type. I suspect some of them probably saw more abdominal wounds than we did. What else would you say Jim?

DR. GARRICK - I think those observations are accurate.

DR. CAREY - As Dr. Garrick has pointed out the plan was to get this study organized. To take six corpsmen and after training them to send 2 or 3 to other kinds of facilities like a Marine Hospital to study casualties there. Of course, as things worked out we never accomplished it. Jim and I both rotated back and the project ended.

CAPT ADAMS - Did you have any opportunity to observe the local triage area? Al Wilson set this up with the 3rd Division before I went out. When there was to be a Battalion or Regiment size operation we would send a detachment to the Medical Battalion in the area nearest to the logistic support area. All the casualties were brought there and hopefully held there and then farmed out for resuscitation, etc.

DR. CAREY - No matter how good the instructions are to that team in the field, if they don't know what the current capabilities are at the area to which they are sending patients, it doesn't help.

CAPT ADAMS - The design at that time was to have someone decide where to send the casualties. They were provided with the information to decide where to send them. I was curious to know what effect this one stop had?

DR. GARRICK - I do not think anything of that nature was ever set up.

DR. CAREY - We didn't notice it at our level, and we were not aware

of any patients who had been managed that way.

CAPT ADAMS - It's very likely they got to the Marine facilities rather than Danang. But Al had started it when he was out there and I picked up the idea. I thought maybe you had developed it a little bit further.

DR. GARRICK - The individual who knows more about casualty evacuation, is Roger Houser. Roger Houser is out of the service now and is practicing in the Los Angeles area. Out of the 12 month tour in Vietnam, Roger spent 3 months in the field chasing regiments, (in the then so called shock and resuscitation therapy), before he went home. Roger's particular figures shows a system that functions very well in collecting information, if you know how to use it. What he actually did was to keep track of the patients by category and what patients he sent to each installation. In this way, he had an idea how far backed up they were. This worked admirably so long as some arbitrary decision was not made. For example, during the long lasting operation north of Hue, the REPOSE was offshore and back up for about 12 hours in their operating room. He didn't know the ship was loaded in operating room cases. The line command was insistent that the helicopters bearing casualty loads go to the REPOSE instead of the triage area operating rooms for assistance and then to Danang. At that time there were 8 huge operating rooms at Danang. So you see how tangled the ordering pattern can become. Roger solved the problem by keeping his head and keeping good records. He could also do efficient work on evacuation. He noted that minor cases, that were using helicopter capability for less than necessary clinical reasons, could

be collected and put in the helicopter with a single urgent case. One thing has to be said to clarify some of the problems in the field regarding helicopter treatment and my experience is prior to 1965-1966. At this time there were few strong outfits in the field and the greatest concentration of activity was on patrols. We found that the Marines were bogged down by somebody who had a couple of shrapnel wounds in his leg. He couldn't be left lying in enemy territory. At that time, once you were outside shouting distance you were in enemy country and if you weren't completely mobile and completely effective the entire mission was bogged down.

CAPT MILLER - I agree with Jess, that it is impossible, I think to train corpsmen to be better triage officers in the field. I think to a great extent they did pretty well on that score, but I would like to point out that a good many of these decisions were technical and not practical.

DR. CAREY - I think that what Jim and I were saying, is that we're not so convinced that the object of their mission is to make the corpsman in the field a better triage officer. It has been demonstrated that he isn't very efficient in terms of separating severe injuries from relatively minor injuries. The lesson is not to put him in the position of being responsible to make that decision to get the patient a place where he can be cared for.

CAPT MILLER - Do you think that was done?

DR. CAREY - Yes, I think it was.

CAPT ADAMS - Then in other words he can't make a decision and make it stick because the first John or the second John said get that man out of here.

DR. CAREY - That's exactly right.

CAPT ADAMS - Well, then the corpsman is not a person with enough stature to say "you go to hell, this guy is going to stay all night because he doesn't need to go".

DR. CAREY - That's true - but again the tactical situation might be the dictating factor and there is no way of getting around that.

DR. GARRICK - Now, we have seen other things happen. We have seen for example, where a helicopter was called in for a medical evacuation for someone who didn't need to go right then. By the same token that helicopter might have gone in under an extreme adverse tactical situation. He may have been shot down. Everyone knows we lost a lot of helicopters and I'm reasonably positive that there were a number of losses that were on missions to evacuate casualties that were less than emergencies.

DR. CAREY - There are some other areas, just in view of the comments you have made, that might bear a little thought. One is a thing as simple as triage area size. I would imagine that if there was any single thing that deterred from the medical purpose of the hospital ships it was "they didn't have any triage variance".

CAPT ADAMS - I would appreciate the Bureau's feeling on how big and roughly what facilities ought to go into the triage area.

DR. CAREY - You saw the size of the facilities we had.

CAPT ADAMS - Yes, quonsets. Well, I can build one of those without difficulty.

DR. GARRICK - Then there is the peripheral areas that handle another 20 to 40 litters. During the period of time I was there, the number of

times that was inundated with casualties were very few. I think it is important to have unencumbered space. It should be virgin space that you only use when you've got a lot of people and it has to have hangers on the ceiling and little things like that. When I was at the University of California we were setting up a mass casualty type program. It went very smoothly until it dawned on somebody "where and what are we going to hang the IV 's from". There weren't enough surgeons and there was not enough room. I think an adequate triage area is where you could walk all the way around each litter to examine a patient and where you can carry litters through to the x-ray unit. I think this is the first thing we learned. The second thing we learned, was in setting up a casualty triage training program. An exercise where you actually get a patient load and you are told what facilities you have and have to go ahead and triage them. The biggest bottle neck aside from the lack of anesthesiologists was the x-ray facility. The x-ray facility we used, just one unit, was always backed up on processing. It had one door that you could use and it wasn't a flow through. People had to go in and out the same door.

CAPT ADAMS - Have you made any use of the portable x-ray in the triage area.

DR. CAREY - Yes, and when I got back, this is what we addressed ourselves to on the LST tank deck, the idea that "you know what you need for triage patients". You need room, some experienced people and x-ray equipment. A portable one would have been a God-send.

(Speaker unidentified) - Let me make one suggestion concerning construction. If you are going to use quonset huts put them on a Wing Wall.

A Wing Wall is a 2 foot high concrete wall. You can gain immense amount of space along the edge of them. Then you wouldn't have to walk around stooped over.

(Speaker unidentified) - Could you give some specifications so that the Bureau would have some idea of the size needed?⁵

DR. CAREY - Yes, but I would have to measure an area off and put a table in it, because size is a very important thing.

(Speaker unidentified) - What are we talking about?

DR. CAREY - Operating rooms.

(Speaker unidentified) - They are about 20 x 80.

DR. CAREY - That the usual standard size for civilian hospitals. What's a quonset hut, 80 x 40?

(Speaker unidentified) - You can get them as small or as large as you want.

DR. CAREY - I know, but what is the standard quonset size or isn't there a standard size.

(Speaker unidentified) - Yes, 24 x 48 or 24 by what ever length you want. The standard size is 20 x 48.

⁵The Bureau of Medicine and Surgery currently has under study the ABFC System (Advanced Base Functional Component System) which will completely modernize our combat zone hospitals and will provide a pleasant, efficient, functional atmosphere for both the medical department personnel and patients.

DR. CAREY - Then, I think the quonsets we had for operating rooms were 20 x 48, and 16 or 14 feet of that 20 was useable because when you get closer to the wall you can't stand up.

(Speaker unidentified) - When we built the initial operating rooms in quonset huts we put them on 2 foot Wing Walls. We cut a slice out of the center of them and had a side entrance. We took this 8 foot segment, right as you go into the entry way, and used it for a scrub and ancillary area. This left a 20 x 20 operating room.

DR. CAREY - That size was adequate. You had ample room, but anything smaller than that is too small. Our quonsets were not equally divided. There was a big operating room and little operating room in each quonset and the little operating room was just that. You know 2 people could work but, that was it - if you had somebody with injuries involving all 4 extremities, the abdomen and the head, there wasn't any way on God's earth you were going to be able to work on him.

CAPT ADAMS - I agree, but what other areas were concerned?

DR. CAREY - Scrubbing facilities - you know if you are going to have 8 people scrub simultaneously, you need sinks and that was a problem.

(Speaker unidentified) - Sure was, and particularly water, it was a problem.

DR. CAREY - Yes, indeed it was.

(Speaker unidentified) - We hung up lyster bags in the scrub area for the surgeons to use.

DR. CAREY - Yes, and I'm sure they worked very well.

CAPT ADAMS - Given the number of operating tables, about how many triage spaces should be provided. Do you think a 20:1 ratio would suffice?

DR. GARRICK - I wouldn't shoot that high, would you Larry?

DR. CAREY - Jim, I think we had about 5 operating tables and we had the capacity to have 50 triage spaces.

CAPT ADAMS - That's about 10:1.

DR. GARRICK - It was very rare that we used all of our triage area.

DR. CAREY - I think about 5 or 6 to 1 would have been more realistic.

CAPT ADAMS - That was 5% of your requirement and you could probably get away with 5 or 6 to 1?

DR. CAREY - Yes, very easily.

DR. GARRICK - If you have an overflow area, for example, where you can get the walking and minor injuries out of the triage area immediately, then this is the secret to needing a relatively small triage area. The overflow area should be a good sized area. You have to take 20 out of a group of 40 casualties and immediately eliminate them from the triage area. You can identify them because they have wounds that can be managed more easily.

CAPT ADAMS - But can you identify them as to what situation they will need.

DR. CAREY - Yes, you can.

CAPT ADAMS - But were you thinking about things such as stretchers, beds, etc.

DR. CAREY - Well, for this group that you separate, all you need for them generally is benches. Benches under cover. You don't need litter space, so you could get 4 of those people into the space that would take 1 litter. Another big factor or course is climate. As long as you are working in a place where it is warm all the time you don't have any problem.

CAPT ADAMS - What if you are where it is cold.

DR. CAREY - That becomes another problem, and I'd rather not be there.

DR. GARRICK - I think that it should be brought out that within a couple of months after we left the place, they got twice as many operations and operating rooms down there. They did not enlarge the triage area and never had a problem they couldn't handle.

DR. CAREY - The other critical area was the intensive care area, the immediate post-operative recovery room. The unit was frequently crowded. The reason was that the recovery unit was staffed by people who were, very good at watching sick patients. We had other rooms and other beds, but we didn't have the people who were as experienced. We didn't have the facilities to move them to other beds, so the recovery unit has to be of a pretty ample size.

CAPT ADAMS - Out of curiosity what was the size, about 12 feet?

DR. CAREY - About 12 feet I think.

CAPT ADAMS - That was rather small wasn't it?

DR. CAREY - Yes, but later it was doubled. You know you end up having to make decisions that you'd like not to have to make.

CAPT ADAMS - What was your holding time?

DR. GARRICK - This group of people that we studied, in the shock unit for example, were the most seriously injured of the casualties. There were 66 of these and most all of them were evacuated within 4 days.

DR. CAREY - Dick will you be the clearing house for information that people want from us?

CAPT BERNSTINE - We're going to try and put this discussion together and send it out to everyone who attended and hopefully they will respond and decide how we should do in the future. Why don't you go on with some of the ordnance information. I think that would be of more interest.

DR. GARRICK - We felt that you might be interested in excerpts from a couple of the sound slide presentations we put together. The first one is on management of open combat type wounds, on general debridement and on delayed primary closure. These are just some of the slides from the sound slide presentation. The entire talk has about 40 slides and takes about 20 - 25 minutes. The second one deals with problems of specific ordnance that we encountered. I think that one of the most important things that should come out of this kind of teaching aid is getting people ready to face these problems. If one sees pictures of the injuries then maybe it will make the learning a little easier. The general problems the slides illustrate are the same as in civilian type trauma, but the severity and extent of the wounds are of a greater magnitude. The military casualty presents some unique problems. The series presents general surgical principals for management of the wounds. You don't try to take short cuts. You clean the wound and prepare the patient as you would for any type of operation. The large amount of dirt in these wounds requires

some surgical cleansing of the area prior to entering the operating room. This procedure helps maintain some cleanliness for the actual surgery.

Surgical incisions merit some comment at this time. Everyone made ellipse incisions for debridement of wounds since they are easier to close. You can make two types of ellipse incisions.

In one instance you save about 50% more skin. It may seem like a minor point but when you have many areas that require debridement, one cannot waste 1/2 square inch of skin for each wound. There will not be enough skin to cover the defects.

The following slides illustrate improper debridement of the wounds with subsequent infection. The next patient was in the field for 48 hours without medical care. He received a gunshot wound in his left hand and grenade wound in his right hand. When he was found the wound looked horrible, but 1 mm underneath the debris there was good viable healthy tissue. I think the best teaching lesson is that wounds that are left open, even though they smell bad and have maggots on them and they look horrible, they really aren't so bad because you don't have devastating type of infection. This was a major problem. As Captain Adams indicated, everybody had to learn all over again that you just don't close wounds; at least you don't close most wounds.

Improper drainage of wounds cause problems. You can cleanse them, prep them before surgery and do excellent surgical procedures with good debridement and leave the wounds open. Some of them are so deep that they require drains.

I would like to present a few slides to illustrate the problem one

encounters with the wounds from specific ordnance. They will demonstrate the unique aspects of wounds caused by mines, booby traps, fleshettes and other ordnance. A mine explosion may not produce external wounds but will produce severe internal destruction. This casualty had no external wounds, but the force of the explosion blew his entire tibia through his boot.

The kind of material that we found in these wounds varied. The mines and booby traps had been made with such strange things. There was a bit of everything, including carpet tacks, some shrapnel from our own ordnance that the enemy had picked up and packed in the booby trap. The next slide illustrates the wound of an individual who was walking behind on a sweep type mission. He was walking about 8 feet behind another fellow who stepped on a mine. In his wounds, there are strange appearing objects on x-rays. They came from the first casualty's boot. Bone fragments from the foot of the first casualty are apparent, as well. The secondary missiles from the booby trap injuries are sometimes odd. X-rays are required to completely define the problem.

Another area where we had problems was either by booby traps, grenade, or rocket being exploded behind the man when he was lying down. He would sustain the shrapnel wounds through the soles of his shoes. Multiple fragments are evident in x-ray, the fragments, themselves, are not the problem. We probably could leave in the majority of fragments, but if the fragments are not removed, one doesn't know what lies deep to them. Many times pieces of clothing or what ever was punched in ahead of the fragment and lie deep. At debridement, the surgeon removes the

grenade fragment and finds a little square of his fatigues that is just the same shape as the fragment. This is what causes the problem. I don't know if there is some kind of material that the body tolerates better than wool that you could use to make socks. It is very difficult to pull the little strands of wool out of these wounds of the feet. If you didn't get all of it, the wool that remains causes secondary infection.

We saw a few pungi stake injuries. They always involved the web space between the 4th and 5th toe. We thought this was quite strange. It really doesn't matter where the pungi stake stuck the foot because this type of wound invariably puts the man into the evacuation chain. If we had the beds, and facilities to keep him he would have been confined or out of combat for at least a month.

To find out why the injuries were consistently in one area of the foot, we took x-rays with their boots on and the pungi stake in place. The reason the stake always wound up out in this web area of the foot was because the steel shank allowed it to glance off, but it didn't deflect it sufficiently to miss the foot. The steel shank or steel sole plate to protect against wounding of this sort should be larger.

Flechettes are presented for interest sake. We didn't see many wounds due to them but there is some interesting things about flechettes. I don't know their composition. They are not very radio-opaque. Some casualties did not realize they had been wounded until a day later, when they started to have pain. The entry wound is very difficult or impossible to detect. When they enter the fins produce a little cruciate incision in the skin. The corners fold in following entry and obscure

the wound. You must have good x-ray equipment to see the thing on x-ray.

Weapon effectiveness was evaluated. We tried to classify wounds, particularly the M26 and M79 type weapons, because when you get the fragments back they are well ear marked. The M26 grenade has to be one of the most devastating weapons imaginable. We had many cases involving them because they were used as detonators for the mines and booby traps. I never saw more than 2 fragments together from an implant of an M26. The Chinese communist grenade fragments are different. One-half of the grenade would come off in one piece. It's easy to separate fragments of the M26 grenade from grenades launched by M79. The M26 fragments are small enough so they usually won't take a piece of cloth in with them but they tear through the fibers. Their velocity is also much greater. If it is a low velocity type, then you have to go in and get the clothing out.

CAPT ADAMS - Has this information been discussed with other units?

DR. GARRICK - When I got back Captain Brodine in the Medical School went to 3 sessions at Pendleton and presented about a 2 hour briefing on triage.

CAPT ADAMS - I would like to see this type of training be given. I'm well aware of what you went through.

DR. CAREY - The other thing that I think is important is somebody who has been there, who had treated the casualties be available for a 2 hour session with these people. They will have many questions to ask in the discussion if it is a free-wheeling sort of session.

CAPT ADAMS - Well, I think another great problem is the lack of

people who know how to talk about it and put it across to stimulate interest.

DR. GARRICK - I think we can get you a cadre of 10 - 20 people very easily. One of the things we have to put into context is the fact that on the Marine's side of the house you are not looking for anymore NSA. In otherwords, we hope to be able to get in and have a hospital established in a very short time.

CAPT ADAMS - It's an established fact that NSA's have never been recognized.

(Speaker unidentified) - I disagree with that completely. We have had base type hospitals in every conflict we've been in except World War I.

DR. CAREY - This is probably based on the Navy side where as it might not be on the Marine side of the hospital. We're trying to establish a short term type facility. The type of facility required bears a relationship to patient care to be performed. The personnel we use, whether we have a neurosurgeon in each one of these hospitals; whether we have 2 or 3 operating rooms with a 50 - 60 bed count.

(Speaker unidentified) - I don't know the absolute figures, but I suspect that if you could tell us the kind of unit of operation you are going to conduct and what you estimate the casualty generation to be and what kind of ordnance you think the enemy has, we can tell you what you need as to people, space, blood, etc.

CAPT ADAMS - We need information which is difficult to obtain but presumably if we could get much needed rules, given expected casualties in so many days, we could provide an efficient operating

room capacity. We need to know how long the people are going to be immobilized in a primary treatment facility. How many casualties are we going to have to get out of the country and how fast. We could have an evacuation problem for a long, long time.

DR. GARRICK - I think we should be able to do that and we should be able to tell you what kind of doctors would be needed. How many anesthesiologists for how many surgeons.

CAPT. ADAMS - Yes, it makes a difference in staffing and keeping the people busy. I found that that was the biggest problem, keeping them busy.

DR. GARRICK - Looking strictly from the military standpoint to try and develop the number of casualties, to provide an organization for casualty handling and an effective evacuation plan, is one thing I think would help.

(Speaker unidentified) - I thought you did a very good job of looking at the evacuation problem because it's very complex. We don't take care of all of our casualties, and we aren't expected to either. We evacuate them to U. S. hospitals or some place in that area for further care. We need some rule of thumb. The Marines, I think can tell you that you can expect so many casualties in a certain and different situations. You have to have an organization structure say if you expect 10 casualties per 1000 per day.

CAPT ADAMS - Granted that you're not going to be able to say such and such unless you know the weapons in back of the mission that cause such and such percentage of casualties. There are still approximations

that can be made. I think that you are not going to be terribly wrong.

DR. CAREY - What you are dealing with are explosive ordnance, gunshot wounds and the distribution of the wounds. These probably won't change very much. When you start dealing in other kinds of devices such as nuclear devices, burns, or things that we didn't see in any great number then the rules of the game change. You always look at the type of wounds caused by new ordnance almost on an individual basis for baseline treatment.

CAPT ADAMS - Your experience is diverse from the usual experience, I know mine differed from yours and I'm sure most everybody else found out that they could receive everything in their facility including the minor wounds. The minor wounds probably have not changed in the four conflicts. In our experience we had a significant number of what you would classify minor wounds, but there really aren't any minor wounds. You know your talking about a mold for everything if it is treated properly. If it isn't treated properly then you have an infection rate and complication rate.

CAPT ADAMS - The wounds are minor in terms of health, but they are not minor in terms of combat efficiency.

DR. CAREY - We probably got a higher proportion of our single fragment penetrating chest wounds back to duty without leaving the country than we did penetrating extremity wounds.

(Speaker unidentified) - One thing that impressed me was you mentioned there were things the field x-ray would not detect. How good of an x-ray machine do we need for this type of missile (flechette).

I don't know what you said it was made of.

DR. CAREY - If you are involved with many casualties with flechette wounds a whole facility might be stifled because of an inadequate x-ray facility.

CAPT ADAMS - Did you use the magnetic metal locator?

DR. CAREY - No.

DR. GARRICK - I don't think we had them.

DR. CAREY - Just from the figures we have here, the 200 abdomens that were explored there also were 186 abdominal wounds. Most of them weren't explored on the basis of x-ray evidence of no fragments within the abdominal cavity.

DR. GARRICK - Even at that we had the highest rate of abdomen operations that's ever been reported.

DR. CAREY - You know you take radiolucent fragments and you double the number of abdominal operations. The usual rate of abdomen operations completed and reported in serious combat runs about 12 - 25% and our average was 30, so I don't think it was a matter of not being super cautious. We opened any abdomen when there was any doubt and we still had almost an equal number that had not been operated.

The supply problem is very important. I can think just off hand of some supply items that just killed us. One thing was that orthopedic service almost came to a halt at one time because all 3 of the orthopedic service electric cast cutters burned up at the same time. You know you don't think about a cast cutter being very important. Well, we had a couple of hundred fractured femurs and these people

had to go into spicas as soon as their debridement was carried out, and to redress them you had to split their spica before they could be put on a medevac plane.

(Speaker unidentified)- I cannot understand why the manager of the orthopedic branch should have this problem with modern day communication. I think that such a foul up is unexcusable. When you have 3 cutters burned out you should have been able to send a wire to Philadelphia. I don't know whether you did or not but I'm certain you'd be able to do it in the future. Practically all of our major ships have satellite capabilities.

DR. CAREY - We got the cutters, but I can't remember where we obtained them. We can back figure from this little thing as how much plaster do you need. That isn't difficult and something about dressings. This kind of information wouldn't be hard to obtain.

(Speaker unidentified) - I would quote "that all major medical supplies should be worked by air in the future conquests". This is why I'm very luke warm about stockpiling to carry on an attack. We ran a daily shuttle of troops to Vietnam for support and if people can talk to Washington once a day on personnel problems they certainly can slip in a word about other problems.

DR. GARRICK - What Larry pointed out earlier was that generally equipment and supplies were not one of our problems. We had better equipment than I have seen in any civilian hospital. It was interesting because we could get some things and the Marines could get some things yet we could not get the same things. They could get 4 inch plaster and we could get 6 inch plaster. There wasn't any way the

Marines could get 6 inch plaster through their supply channel or could we get 4 inch plaster through our supply chain; but as long as you were in the same area it worked out alright because we could swap. We can tell you what you need for your job if the job and circumstances are the same as they were for this particular study. What we can probably better tell you that will be more useful is just how can you go about getting this kind of information for any given conflict.

DR. CAREY - Having completed this study we could tell you where the pitfalls are, where manpower needs are, in addition to giving you the benefit of what ever data we obtained in this situation.

CAPT BERNSTINE - The hour is late and we must finish at this time. I want to thank Dr. Carey and Dr. Garrick for coming and the entire group for participating. We will get the minutes of the meeting to the participants for comment.